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Sol-gel Silica Nanoparticles in Medicine: A Natural Choice. Design, Synthesis and Products

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Silica is one of the most abundant minerals in the Earth's crust, and over time it has been introduced first into human life and later into engineering. Silica is present in the food chain and in the human body. As a biomaterial, silica is widely used in dentistry, orthopedics, and dermatology. Recently amorphous sol-gel SiO2 nanoparticles (NPs) have appeared as nanocarriers in a wide range of medical applications, namely in drug/gene target delivery and imaging diagnosis, where they stand out for their high biocompatibility, hydrophilicity, enormous flexibility for surface modification with a high payload capacity, and prolonged blood circulation time. The sol-gel process is an extremely versatile bottom-up methodology used in the synthesis of silica NPs, offering a great variety of chemical possibilities, such as high homogeneity and purity, along with full scale pH processing. By introducing organic functional groups or surfactants during the sol-gel process, ORMOSIL NPs or mesoporous NPs are produced. Colloidal route, biomimetic synthesis, solution route and template synthesis (the main sol-gel methods to produce monosized silica nanoparticles) are compared and discussed. This short review goes over some of the emerging approaches in the field of non-porous sol-gel silica NPs aiming at medical applications, centered on the syntheses processes used.

Biography

M. Clara Gonçalves graduated in Chemical Engineering (IST, Universidade Técnica de Lisboa) though her scientific career has been developed in Materials Science. She started as a scholarship at LNETI (Ceramic Group) (1985) and as visiting researcher at Instituto de Cerámica y Vídrio, Madrid, Spain. In 1986 she joined the IST as a Trainee Assistant where she obtained her PhD degree in Materials Science, in 1993. She was a visiting researcher at Instituto de Física e Química de São Carlos, Universidade de São Paulo, Brasil, in 1990 (Prof. Michel Aegerter's group), and at Laboratoire de Chimie Moléculaire, Université de Nice Sophia-Antipolis, France, in 1996 (Prof. Liliana Hubert-Pfalzgraf's group) and post-doc at the Chemistry Department of Southampton University, UK (Prof. George S. Attard's group) (2000). Her research is carried out at CQE/IST and her interests include the two overlapping areas: metastable materials (glasses, nanoparticles, photonic materials) and hybrid matrices (inorganic-organic)

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